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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method of and Means for Converting Thermoplastic Synthetic Plastics Waste Material into Non-Caking Granules

We, FELLNER & ZIEGLER GMBH, a German Body Corporate of 6 Frankfurt/M. West, Kreuznacher Str. 29, Germany, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

THIS INVENTION relates to a method of and means for converting thermoplastic synthetic plastics waste material into non-caking granules.

Methods of converting thermoplastic foil waste, more especially polyethylene foil waste, into non-caking granules by comminution and subsequent consolidation and agglomeration of the comminuted foil waste are known in which the comminuting operation is carried out separately from the following consolidating and agglomerating operation. After comminution in cutting mills, the step of consolidation with this method is usually produced in mixing devices running at high speed in which energy supplied mechanically by the mixing tools to the batch or charge is converted into frictional heat. After sufficient energy has been supplied the material has been heated to such an extent that it is consolidated and agglomerated into the form of granules. Following the agglomeration, a cooling and loosening process is effected in a separate apparatus in order to produce a non-caking granulated material. This method is costly as regards equipment and is uneconomic as regards energy supply. Furthermore, it is found to be a disadvantage that a continuous comminuting operation is followed by a batch consolidating and agglomerating operation, as well as by the cooling and loosening operation. Furthermore, difficulties arise in measuring the amounts of foil to be supplied to the comminuting machine.

Accordingly, attempts have already been made to carry out the comminution, the consolidation and the agglomeration, as well as the subsequent air-cooling and loosening, continuously and successively in separate apparatus. Such a method, although carried out continuously, does however make it necessary to have a relatively accurate supply of measured quantities for all of the stages, especially for the comminution stage, and this can only be effected with great difficulty, because the foil waste can only be taken up and conveyed in an unsatisfactory manner by distributors. The success of such a method is always very highly dependent on the skill of the operator or on the expenditure which one is prepared to incur for accurate control.

The invention provides a method of and a means for converting the waste of thermoplastic synthetic plastics, for example, foils, parts of thin blown elements, such as cups, packing, etc. into non-caking granules, in which the granules can be obtained in a single working step in a manner which is simple so far as the technical procedure and apparatus are concerned.

According to one aspect of the present invention there is provided a method by which the waste of thermoplastic plastics material is converted into a non-caking granulated material, in which the waste material is introduced batchwise into a container and is processed in the latter by moving beater members until it is comminuted and is consolidated and agglomerated by cohesion arising from the heat energy supplied to the material by the movement of the beater members, and in which while the beater members continue to operate, the agglomerated foil waste is cooled by the supply of a coolant.

During the cooling step, the temperature

of the agglomerated foil waste is lowered, at least on the surface, to such an extent that it is no longer possible for the granulated particles thereby obtained to cake together. Various cooling media may be considered for the cooling operation. The cooling of the agglomerated foil waste by the injection of a liquid has proved to be particularly suitable. Water may be used as the cooling liquid, but other liquids may be used with advantage. A coolant gas may optionally be used as an additional coolant, the gas being introduced into the container during the last part of the process for cooling the agglomerated foil waste. By the combined use of a liquid and a coolant gas, it is possible to achieve a quick drying of the granulated material as well as an intensive cooling by the liquid, this drying being assisted by the natural heat of the granules. The cooled, granulated material can advantageously be discharged pneumatically from the container by means of the coolant gas.

If it is not possible on technological grounds to work with a coolant liquid and if it is not desirable to use only coolant gas for the cooling operation, on account of the large volumes of gas which are necessary, it has surprisingly been found that the cooling of the agglomerated foil waste can also be effected by adding the comminuted and advantageously thermoplastic plastics material in a given quantity according to the quantity of charge which is in the container. The plastics material added for cooling the agglomerated foil waste is preferably either in the form of foil shreds or in the form of powder or consists of already agglomerated and cooled foil waste, which originates for example from a preceding charge or batch. The quantity of plastics added for the cooling operation can consist of the same material as the plastics waste or foils agglomerated by the method according to the invention or of another material. The addition of the plastics material may be made at the same time as liquid is usually injected or coolant gas is introduced for cooling purposes. The granulated materials or agglomerates which are formed in the preceding processing step are covered on their surface by the plastics material added for the cooling operation and are cooled on said surface. This effect is sufficient to avoid the agglomerates or granulated materials sticking together after they have left the container. The non-caking character of the granulated material is thus maintained. For cooling purposes, it is advantageous to add a quantity of plastics material which is about 10% of the quantity which is in the container. This quantity has proved to be very desirable.

Coolant gas can additionally be also introduced when plastics material is added for cooling purposes. The coolant gas in this case can also be used for pneumatically discharging the granulated material from the container and optionally for providing additional cooling in the connected conveyor pipes.

If plastics material is used for cooling purposes, this has the advantage that no changes can occur in the foil material due to the cooling and that also the machines for further processing the agglomerates are not affected by residues of liquid or vapours and there is no need to provide separate intermediate processing steps to drive off such residual quantities.

Due to the fact that the foil waste to be granulated is introduced in batches into the container equipped with rotating beater members, any problems with regard to the measuring of quantities, such as those which arise with the continuous introduction of foil waste in measured quantities into comminuting machines, are avoided. However, a substantially continuous working procedure is also possible if the filling operation, the driving period of the beater members, the addition of coolant and the emptying are controlled by a timing device or other control means. The granulated material emptied from the container can be delivered into a hopper, from which it is continuously supplied by means of a continuous conveyor to a following extruder. The finished granulated material can of course also be delivered directly into the supply hopper of an apparatus for the further processing thereof.

More especially when the cooling is effected only by the injection of a liquid, it is advantageous to inject just sufficient liquid for this to be completely evaporated during the cooling of the granules. Any subsequent drying of the granules which may be necessary can occur in the following pneumatic conveyor devices. Thus it may be ensured that no moisture is evaporated during the further processing of the granulated material, particularly during extrusion, which could lead to difficulties. If the cooling is effected by injected liquid, the discharge of the cooled granules is generally made with the beater members continuing to run, since this assists the discharge and avoids the agglomeration of the granules on discharge.

In some cases, especially when the granulated material is to be conveyed by pneumatic means to the place of use, it is advantageous for the cooled granulated material to be discharged by coolant gas pneumatically from the container. In this case, gas nozzles of a gas-inlet system will preferably be arranged on the bottom of the container and an outlet will be provided in

the upper part of the container. This arrangement ensures that there is an intensive mixing and cooling of the material as a result of the thorough rotation of the agglomerated foils and by co-operation with the beater members, and it is thereby ensured that there is a discharge only of such granulated material which has been thoroughly exposed to the coolant.

It may also be desirable for the energy which can be supplied to the agglomerated foil waste by the beater members to be reduced during the cooling operation. For this purpose, a pole-changing driving motor may, for example, be provided for the beater members, which motor is switched to a slower speed during the cooling operation.

With the introduction of the coolant for cooling purposes, other components can be added, which are mixed or are to react chemically with the agglomerated foil waste. The substances to be admixed can be supplied in dry, dissolved or emulsified form. It is also possible to add substances which accelerate a solidification of the agglomerated foil waste.

As the processing steps comprising comminution, consolidation, agglomeration, cooling, loosening and possibly drying are all carried out one after the other in a single chamber, the apparatus necessary for carrying out the method becomes very simple.

According to a second aspect of the present invention there is provided apparatus which includes a vertically disposed container having an inlet and an outlet for the waste, in the lower part of which container there are provided beater members arranged to revolve about a vertical axis and fixed comminuting members arranged to co-operate with the beater members, which comminuting members project from the container wall into the interior of the container, said beater members and/or comminuting members being radially adjustable in planes perpendicular to the vertical axis, and means for the introduction of a fluid cooling medium.

The beater members can usefully be constructed as arms carrying radially adjustable beater bars, which can be easily replaced after they have become worn, and the beater can be arranged to be axially adjustable in the container. The fixed comminution members are also preferably so designed that they are adjustable radially of and/or parallel to the vertical axis of the container.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings which show in Figure 1 a sectioned elevational view of an apparatus and in Figure 2 a plan view of the apparatus.

Referring to the drawings there is shown a cylindrical container 13 which rests on a main frame 1, in which a driving motor 2 is arranged so as to be adjustable axially in the direction a-b. The hub 3 of the motor projects through packing 14 and the bottom 12 of the container into the interior of the latter. Beater members fixed on the hub 3 of the motor shaft are in the form of beater arms 4, on which beater bars 5 are fixed by means of clamping plates 6. Fixed comminuting members in the form of plates or pins 8 are provided on the circumference of the cylindrical part of the container 13 at approximately the same height as the beater members. The plates 8 are adjustable radially in the direction c-d and can be secured in the required position by the clamping bar 7. Formed in the container cover 10 is a filling opening 11 which optionally can be closed and the diameter of which must not exceed a certain dimension, in order to prevent the egress of the portions of foil waste projected upwardly by the beating action during the comminution and agglomeration. The outlet 9 is provided on the cylindrical portion of the container immediately above the bottom of the latter and it is adapted to be closed by a flap 18. A number of injection nozzles 114 are arranged in the container cover 10 for the supply of liquid for cooling purposes. Corresponding nozzles 15 for the injection of a coolant gas are provided in the container base 12. A pipe 16, to which a fan can be connected, serves for extracting the vapours during the cooling operation. The quantity of foil material in the form of shreds or powders for cooling purposes, which quantity is adapted to the quantity of the batch which is in the container, can be fed through the container cover 10 or through the pipe 16.

Couplings or other filling apertures can obviously also be specifically provided in the cover or in the wall for this purpose, but these are not particularly shown in the figure, since it is understood by the person skilled in the art how and where it is expedient to provide such unions. A thermometer 17 is provided for observing the temperature of the agglomeration process, the thermometer being so arranged that it dips into the filling of material. By means of this thermometer, the injection of liquid and/or the blowing in of coolant gas can be automatically initiated after terminating the agglomerating operation.

Instead of the beater rotor having two blades, it is also possible to provide one having a plurality of beater arms. The beater arms and the fixed comminuting members associated therewith may alternatively be arranged in several planes.

In one application of the invention 60 kg

of waste polyethylene foil was introduced into a cylindrical container having a diameter of 1.1 metres and a height of 1.5 metres. The comminution or the tearing of the foil waste was effected within about 4 minutes at a peripheral speed of the beater arms extending until close to the fixed comminuting plates of about 70 m/sec. The beater members were allowed to run for approximately another 3 minutes, the mechanical work which was performed being for the major part converted into frictional heat and the waste foil being consolidated and agglomerated. As the beater arms continued to run, about 1.5 litres of water at a temperature of 20°C were injected for a brief period, and after 1 minute, the solidified and cooled agglomerate was withdrawn, this agglomerate no longer showing any caking tendency.

WHAT WE CLAIM IS:—

1. A method by which the waste of thermoplastic plastics material is converted into a non-caking granulated material, in which the waste material is introduced batchwise into a container and is processed in the latter by moving beater members until it is comminuted and is consolidated and agglomerated by cohesion arising from the heat energy supplied to the material by the movement of the beater members, and in which while the beater members continue to operate the agglomerated waste is cooled by the supply of a coolant.

2. A method as claimed in claim 1 in which the cooling of the agglomerated waste is effected by the injection of a liquid.

3. A method as claimed in claim 2 in which the quantity of liquid injected is such that it is completely evaporated during the cooling of the granulated material.

4. A method as claimed in claim 1 in which the cooling of the agglomerated waste is effected by the introduction of a coolant gas.

5. A method as claimed in claim 4 in which the cooled granulated material is pneumatically discharged from the container by the coolant gas.

6. A method as claimed in claim 1 in which the cooling of the agglomerated waste is effected by the injection of a liquid and the blowing in of a coolant gas.

7. A method as claimed in claim 6 in which such a quantity of liquid is injected that it is completely evaporated during the cooling of the granulated material.

8. A method as claimed in either claim 6 or claim 7 in which the cooled granulated material is discharged pneumatically from the container by the coolant gas.

9. A method as claimed in claim 1, in which the cooling of the agglomerated waste is effected by the supply of a given quantity of comminuted thermoplastic plastics material, the said quantity being adapted to the quantity of the batch or charge in the container.

10. A method as claimed in claim 9 in which the plastics material serving to cool the agglomerated waste is supplied in the form of foil shreds.

11. A method as claimed in claim 9 in which the plastics material serving to cool the agglomerated waste is supplied in the form of powder.

12. A method as claimed in claim 9 in which the plastics material serving to cool the agglomerated waste is supplied in the form of agglomerated and cooled foil waste.

13. A method as claimed in any one of claims 9 to 12 in which the quantity of plastics material supplied for cooling the agglomerated waste corresponds to approximately 10% of the quantity of batch introduced into the container.

14. A method as claimed in any one of claims 1 to 13 in which the energy supplied to the agglomerated waste by the beater members is reduced during the cooling.

15. Apparatus for use in a method as claimed in any one of claims 1 to 14 which includes a vertically disposed container having an inlet and an outlet for the waste, in the lower part of which container there are provided beater members arranged to revolve about a vertical axis and fixed comminuting members arranged to co-operate with the beater members, which comminuting members project from the container wall into the interior of the container, said beater members and/or comminuting members being radially adjustable in planes perpendicular to the vertical axis, and means for the introduction of a fluid cooling medium.

16. Apparatus as claimed in claim 15, in which the beater members are constructed as beater arms which are adjustable axially of the container and which carry radially adjustable beater bars.

17. Apparatus as claimed in either claim 15 or claim 16 in which the comminuting members are adjustable in a direction radially of and/or parallel to the vertical axis.

18. Apparatus as claimed in claim 15, 16 or 17 including fluid cooling medium inlet nozzles arranged in either the container wall or the waste inlet.

19. Apparatus as claimed in any one of claims 15, 16, 17 and 18 in which gas nozzles of a gas inlet system are provided on the bottom of the container and a gas outlet is provided in the upper part of the container.

20. Apparatus substantially as described with reference to the accompanying drawings.

21. A method by which the waste of thermoplastics material is converted into a

non-caking granulated material substantially as described with reference to the accompanying drawings.

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1 SHEET

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

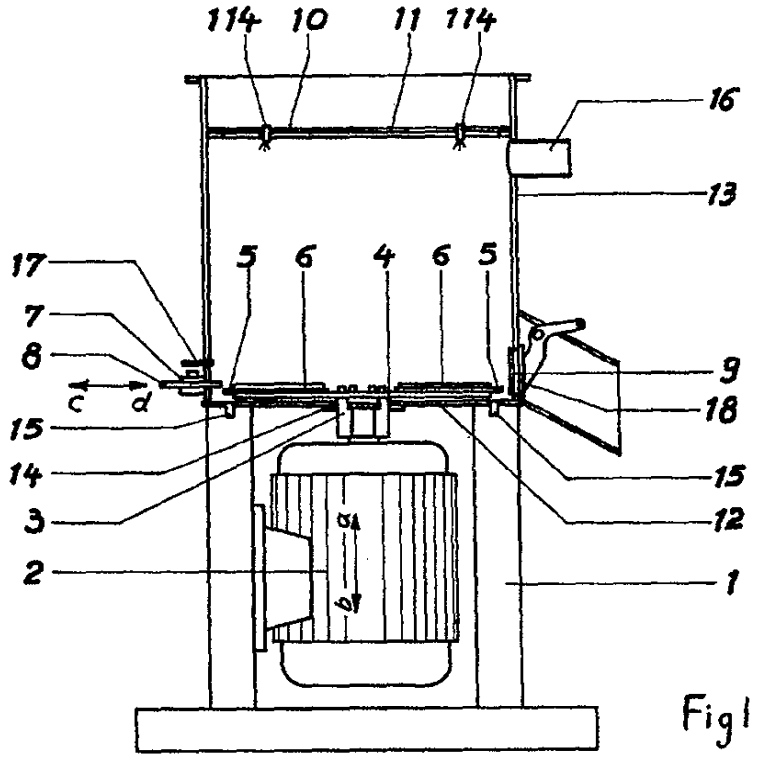

Fig1

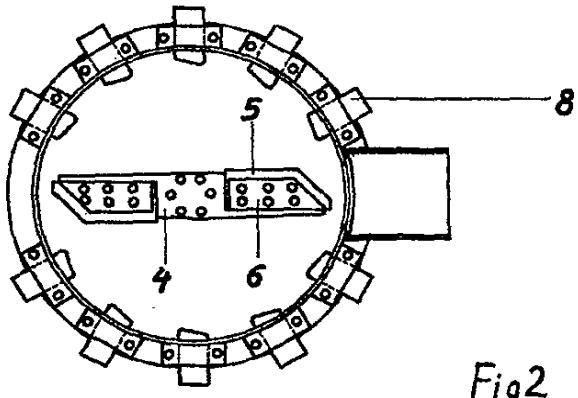

Fig2